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Design and Fabrication of Wheel Chair using Rocker Bogie Mechanism

Arjun CP, Jithin Peter TK, C. Mohamed Meersa, Habeeb Rahman PP

B Tech Student, Department of Mechanical Engineering
Eranad Knowledge City Technical Campus, Malappuram, Kerala, India

ABSTRACT

Rocker bogie finds a vital role in determining the scientific analysis of objectives separated by many distance apart. The mobility design at present is quite a bit complex with many legs or wheels. The wheeled rover which is capable of driving over the rough terrain provided with high degree of mobility suspension system. The drive provided by the rocker bogie is simple and it mainly operated by the means of two motors. The motors are kept inside in order to make it more reliable and efficient. In overcoming the bumps in the natural terrain the wheels are operated simultaneously. By implementing this mechanism the vehicle can come through any obstacles it faces during the travel in the terrain.

KEYWORDS: *wheel chair, Rocker bogie Mechanism*

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I. INTRODUCTION

In order to have his life on earth man must find a way to earn. As the time goes on we must remember of deprived people. We need to find a way to support such a individuals with deprived legs, hands or other parts of the body. They were too dependent on others for everything, so we need to understand their feelings and provide a way to carry out their life. It is difficult for them to migrate from one place to other. The mobility of an individual is being restricted. The small scale manufacturers were keen on their efforts to develop the cycle that suits them but it is not in the case of other transportation facilities. The tricycle invention provided them with increased mobility and independence. So we had an idea of inventing a wheel chair with rocker bogie mechanism. It consists of motor, battery, links and wheels. The suspension design used in this mechanism offers vehicle stability. The rocker bogie suspension finds its first application in Mars Exploration Rover project.

1. MOTIVATION OF WORK

Daisuke Chugo et al.(2006) developed a mechanical design of holomonic mobile vehicle that is capable of running over irregular terrains. The performance of vehicle on rough terrain was increased by using passive linkages in the design. The previous versions of passive linkages which were implemented in this design those where found to improper as their body configuration cannot fit the terrain surface and wheels cannot transmit its traction force. Their prototype mechanism consisted of seven special wheels with free rollers and a passive linkage mechanism. The passive linkage mechanism ensured that the vehicle can pass over the step smoothly when the wheel contacts the step, changing the body configuration of the vehicle. No sensors and no additional actuators are required to pass over the non-flat ground. Rajasekar P et al.(2013) proposed and fabricated a manually operated wheelchair that can travel on both plane terrains and also in the staircases. This design primarily aims at providing stability to the person who travels in the wheel chair and with minimum manufacturing cost. Instead of using normal wheels they have used penta wheel. The steel rod is penta shaped and each rod is equally inclined of 72° from each other. At the time of climbing, one wheel that is the idle wheel will be in contact with the ground and the wheel will be in contact with the stair.

Nitin Yadav et al.(2015) discussed about the mechanical design and its advantages of Rocker- bogie suspension system in order to find suitability to implement it in conventional loading vehicles to enhance their efficiency and also to cut down the maintenance related expenses of conventional suspension systems. They observed that that the main problem associated with current suspension system installed in heavy loading vehicles is their slow speed of motion which derail the rythem to absorb the shocks generated by wheels. They proposed a design a design which aimed at increased at increasing the rocker-bogie mobility system in conventional heavy loading vehicle behavior when high speed traversal is required.

Chinmaya Sukhwal et al. (2016) presented a design of wheelchair for the people suffering from disabilities such as motor impairment. The proposed design mainly focuses on enhancing the wheelchair with the low-level stair climbing feature. The measurements for the wheelchair are selected according to the standard anthropremetric measurements. The proposed wheelchair has been particularly designed to perform stair climbing operations as well as mobility through uneven terrain. The dimensions of the wheelchair seat has been taken with respect to standard measurements of an adult human being as specified by ADA, whereas the dimensions of the frame and wheels are based on the assumption of conventional staircase at home environment.

S.F.Toha (2015) proposed an intelligent inclined motion control of an amphibious vehicle while moving on uneven terrain surface. The trainability helps the vehicle reducing a flipping back and slippage while it on a mission since the terrain surface after a disaster is unpredictable. Thus, applying the controller algorithm will optimizing the vehicle ability to maneuver in any surface condition with minimum risk.

II. LITERATURE REVIEW

A. Recent Rovers And Their Missions

Much of space exploration can be divided into three categories: a quest to better understand our universe, interest, and economic potential in using natural resources outside our planet, and the future, colonization of extra-terrestrial bodies. Furthermore, most interest has been in our moon and mars. As these planetary bodies are close by, and have environments that are hospitable enough for rovers, and potentially for future colorization. The moon is also very well suited for scientific equipment such as radio observatories or IR telescopes as it has no atmosphere, instruments such as these can measure signals that would otherwise be disturbed or eliminated on earth. Interest in mars mostly relates to expanding our knowledge of the planet, specifically with respect to its ability to support a human colony. Learning more about the composition of its atmosphere and soil can tell us whether mars could potentially support microbial life. Since 1976, NASA has been exploring the surface of mars with rovers, starting with the dual landing of Viking 1 and Viking 2 Landers. In 1997, the mars pathfinder (mpf) Lander delivered the sojourner rover to the surface successfully. Most recently, in early 2004, NASA again landed two more rovers on mars, spirit and opportunity. In November 2011, NASA has launched the mars science laboratory (msl) with a rover named curiosity. Despite the multiple rovers that NASA has sent to mars, each mission has similar objectives.

Making improvements from past mars rovers, NASA has continued to develop autonomous navigation to make it easier and quicker to control their rovers, given the relatively large time delays in sending commands. To do this, on-board stereo vision processing was used to develop an image on the environment, which identified positive and negative obstacles relative to the ground plane. The other main features of MERs relate to mobility hardware, which allowed them to traverse the Martian terrain with relative ease. In continuation of past mars rover design, the rocker-bogie suspension was used. It consists of six wheels and multiple axles that allow the rover to overcome obstacles larger than its wheel diameter. The specialized wheels of the rover are approximately 26 centimeters in diameter and have a unique aluminum flexure structure to connect the hub to the rim of the wheel. These flexure joints act as shock absorbers which help to reduce the shock loads on other components of the rover. Each wheel also has small cleats, which have been found to be effective both for soft sandy terrain and in navigating over rocks Curiosity an advantage in terms of its path lining ability. It has a three axis inertial measurement unit (IMU), enabling the rover to make precise movements while also monitoring the degree of tilt that the rover is experiencing. To tackler the mobility challenge, the 900kg rover has a very similar 6 wheel rocker-bogie suspension as previous mars exploration rovers have. The larger size combined with the rocker-bogie suspension allows the rover to go over obstacles 60-75 cm higher, which is greater than its wheel diameter of 50 cm. it can also safety, curiosity also has created treads that are similar to the MER rovers, which were found to be an optimal solution for Martian terrain. With a top speed of 4cm/sec, it was the fastest rover sent to mars.

In reviewing NASA's rovers for surface exploration on mars, there were many similarities in both their mechanical design and software that enable the rovers to perform on-board path planning. Autonomous planetary navigation combined with hazard avoidance and other self-preservation autonomy makes these rovers excellent platforms to reliably transport and position their scientific instruments. The biggest changes between missions have been the size of the rover and the types of scientific instruments it supports. Astrobotic technology inc is one such company that has founded itself on making space exploration profitable, by delivering payloads and performing robotic services on the moon. They are currently in collaboration with Camegie Mellon University and others, to develop a rover and lander for their first surface lunar exploration mission, which it successful will satisfy the X-prize criteria as well as other objectives. Their robot, called red rover, is reviewed here because it is one of the most developed lunar exploration rovers. Red rover is designed to be a scout, exploring places such as polar ice fields or skylights into lunar lava tubes. Its goal is to determine where the interesting locations are based on its analysis of chemical composition and High resolution 3D IMAGES.

The proposed paper produces a novel design in pursue of increasing the rocker-bogie mobility system in conventional heavy loading vehicle behavior when high-speed traversal is required. In future, if the system installed in heavy vehicles and conventional off road vehicles, it will definitely decreases the complexity as well as power requirements to retain bumping within it Future scopes of Rocker Bogie Mechanism are in military operations as a weapon carrier & for locating coal deposits in coal mines. Along with establishing a concept design, robust design parameters are set to minimize performance variation. The Grey-based Taguchi Method is adopted for providing an optimal setting for the design parameters of the robot. The robot prototype is shown to have successfully scaled stairs of varying dimensions, with overhang, thus corroborating the analysis performed. This work shows how rocker bogie system works on different surfaces. As per the different weight acting on link determines torque applied on it. By assuming accurate stair dimensions, accurately dimensioned rocker bogie can climb the stair with great stability During stair climbing test for length less than 375 mm (15 inch) system cannot climb the stair. It can be possible to develop new models of rocker bogie which can climb the stairs having low lengths.

III. DESIGN OF ROCKERS BOGIE

The important factor in manufacturing of rocker bogie mechanism is to determine the dimensions of rocker and bogie linkages and angles between them. The lengths and angles of this mechanism can be changed as per requirement. The aim of this work is to manufacture the rocker bogie mechanism which can overcome the obstacles of 150 mm height (like stones, wooden blocks) and can climb over stairs of height 150 mm. Also another target is to climb any surface at an angle of 45˚. To achieve the above targets we had designed the rocker-bogie model by assuming stair height 150 mm and length 370 mm. Using Pythagoras theorem, we found the dimensions of the model. It have both angles of linkages are 90° and 120°. The objective of the research work is stair climbing. To achieve proper stair climbing the dimensions of linkages should be proper. Assume the stair height and length 150 mm and 370 mm respectively. To climb stairs with higher stability, it is required that only one pair of wheel should be in rising position at a time. Hence to find dimension of bogie linkages, first pair of wheels should be placed at horizontal position means at the end of the rising and second pair should be placed just before the start of rising. There should be some distance between vertical edge of stair and second pair of wheel to striking of wheels. The determination of dimension of rocker and bogie linkages is the key factor in manufacturing of rocker bogie mechanism. Based on the requirements, the dimension can be varied. The main aim of this project is that it overcomes obstacles up to a certain height and up to a certain angle. We assumed stair case of certain height and length, and then by using the Pythagoras theorem, we came up with dimension of the chair. In order to achieve a greater stability only one pair of wheel must be at the rising position. To find the dimension of the linkages we have to place the first pair of wheels horizontally, next pair is placed before rising. A suitable distance is maintained between them.

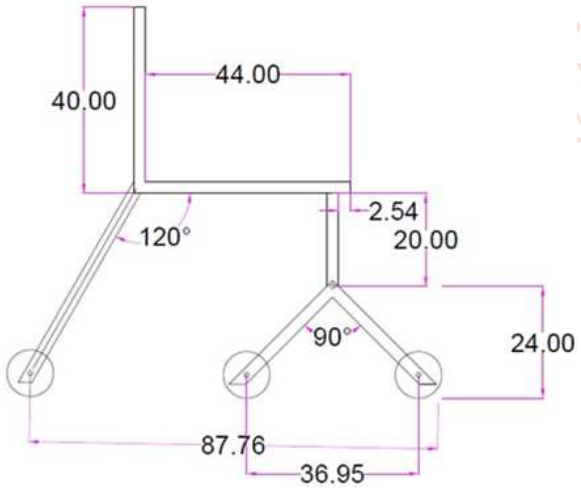


Figure 1: Cad Drawing

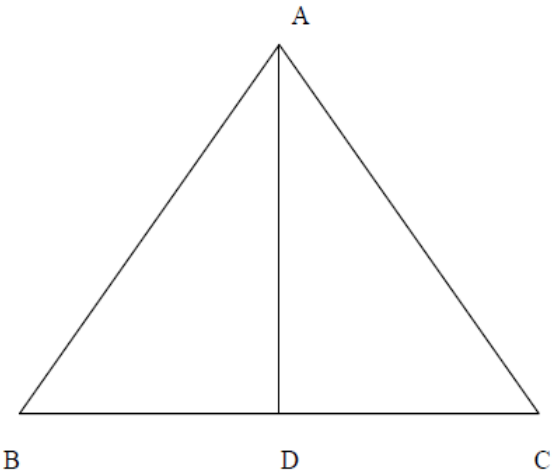
IV. CALCULATIONS

Design calculation

Stair Size: 34cm × 15cm

Distance between the front wheel and middle wheel are calculated by assuming the angle between them to be 90˚

The Length of the link is calculated by using Pythagoras theorem



We have assumed that <BAC =90˚

AD is perpendicular bisector to BC

From the calculation shown above in the figure BC = 38cm

In Δle BDA

Using Pythagoras Theorem

AB2 = BD2 + AD2

By Solving we get the value of AB as 30.6cm

The Link of the Back Wheel is inclined at about 120˚ From the seat.

The angles 90˚ and 120˚ is assumed in order to provide the wheel chair with optimum conditions.

V. CONCLUSION

This project makes it way over the rough terrain. The torque developed will be based on the weight acting on the each of the links. By having accurate measurements of stair we could have a chair with much greater stability. When the chair's rear end faces the stair edge, the posture of the chair is poor. It undergoes a smooth travelling while it travels in the ascending fashion but while coming down it comes up with vibration. So we planned to have a spring and braking system. We put forward with mechanical design for the passive linkages. When the vehicle is made contact with the step the momentum is being calculated from which moment force of the free joint is carried out. Atlast we cross checked the values with the computer simulation software. Here the mechanism is equipped with the minimal control system and successfully tested by moving it over the stairs in the forward and in the reverse direction.

VI. FUTURE SCOPE

In Future, if the system installed in heavy vechiles and conventional heavy loading vechile and conventional off road vechiles, it will definitely decrease the complicity as well as power requirement to retain bumping within it. Future scope in rocker bogie mechanism are in military application as weapon carrier and for locating coal deposts in coal mines.

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